HAWK MIGRATION OVER THE WESTERN TIP OF LAKE SUPERIOR[1]

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Since 1951, members of the Duluth Bird Club and the Minnesota Ornithologists' Union have spent slightly more than 922 hours of 201 days in counting the hawks that pass over the city of Duluth during the fall migration. In this time we have tallied 159,397 individuals, an average of 172+ hawks per hour of observation.

The pattern of flight can be discerned to some extent by studying Tables 1 and 2. The 93,187 Broad-winged Hawks (*Buteo platypterus*) and 33,475 Sharp-shinned Hawks (*Accipiter striatus*) make up nearly 80 per cent of the count (actually they probably make up over 80 per cent, as the 16,852 unidentified hawks more than likely contain a great percentage of these two species). The relative position of the other 12 regular species perhaps does not express accurately the true picture of the flight. There is a bias due to an uneven distribution of observation periods through the three main months of the flight. Prior to 1961, only 28 days were given to the period following the end of the big Broadwing flights in September. Consequently, we have missed, in most years, the peak Red-tailed Hawk (*Buteo jamaicensis*), Rough-legged Hawk (*B. lagopus*), and Goshawk (*Accipiter gentilis*) flights. Prior to 1961, only 80 Goshawks were tallied; since 1961, 1,117 have graced our tally sheets. It was not at all unusual in 1963 to count more Goshawks in a single observation period than we had tallied as a total during the first 10 years of observation. With the exception of these species (Redtail, Roughleg, and Goshawk), the peak flight is over by the first of October. The Broadwing flight drops so abruptly that while there may be thousands recorded by the fourth week of September, only 39 birds have been seen in October, and no migrant Broadwings have been counted after 12 October.

There is some movement before the first of September. The Kestrel (*Falco sparverius*) movement actually may be well under way by this time as large numbers are seen along the telephone wires on North Shore roads. However, there has been no organized August observation, and since Kestrels hug the lakeshore more than do other species, they are missed from the usual observation posts.

One other pattern to round out the picture: on 14 days we have had what we term "AA" flights when average counts per hour were over 400 (the range has been 435 to 2,299). All of these "AA" days have occurred in

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Table 1

The Distribution of total Numbers of Hawks Recorded from 1951 through 1963 at the Duluth Flyway
The days and hours of observation of each month are also shown

Year	Days and Hours of Observation								Sharpshin	Cooper's	Goshawk	Broadwing	Redtail	Roughleg	Kestrel	Merlin	Peregrine	Osprey	Marsh Harrier	Turkey Vulture	Bald Eagle	Golden Eagle	Others	Unidentified	Total Hawks	Hawks/Hour
	Sept.		Oct.		Nov.		Dec.																			
	D	H	D	H	D	H	D	H																		
1951	4	31.7	0	0	0	0	0	0	686	136	7	3,231	71	2	53	9	4	20	69	12	7	6	0	4,616	8,929	281+
1952	4	33.5	1	7.5	0	0	0	0	1,777	304	24	5,338	99	74	144	50	13	32	372	20	7	1	3	5,046	13,304	324+
1953	4	34.2	0	0	0	0	0	0	973	133	4	4,906	223	2	58	9	5	16	256	36	0	1	3	596	7,231	211+
1954	6	33.5	0	0	0	0	0	0	1,704	49	6	1,852	45	0	366	26	4	26	57	36	4	2	0	335	4,512	134+
1955	6	44.7	6	20.2	1	3.5	0	0	3,708	38	16	1,638	716	63	122	39	18	13	176	56	6	1	0	1,320	7,930	115+
1956	7	51	6	12.5	2	2.7	0	0	2,043	87	2	1,309	855	14	108	14	4	25	68	34	6	0	1	569	5,139	77+
1957	10	55.2	2	4.5	0	0	0	0	2,790	31	7	11,124	291	5	245	63	4	39	240	26	6	0	10	340	15,221	255–
1958	6	40.5	0	0	0	0	0	0	5,157	81	5	9,991	113	3	298	50	4	33	339	123	2	0	5	1,898	18,102	447–
1959	9	57	0	0	0	0	0	0	910	8	0	63	23	1	85	8	2	18	49	1	0	0	0	244	1,412	24+
1960	7	39	9	27.7	1	2.5	0	0	2,056	38	9	6,864	636	20	95	14	7	39	117	84	3	1	1	457	10,441	151–
1961	18	88.2	17	35.5	0	0	0	0	5,997	74	69	23,642	661	30	369	20	34	60	426	281	10	2	2	965	32,642	264–
1962	21	116.5	18	51.6	5	5	0	0	3,668	50	333	20,603	1,223	81	217	10	4	45	126	62	8	3	3	279	26,715	154+
1963	16	85.1	11	28.7	3	9.1	1	1.3	2,006	37	715	2,626	1,612	261	133	7	10	39	147	26	15	7	1	187	7,829	63+
Total	118	710.1	70	188.2	12	22.8	1	1.3	33,475	1,066	1,197	93,187	6,568	556	2,293	319	113	405	2,442	797	74	24	29	16,852	159,397	172+

September. "A" days (100–400/hour) have been recorded on 24 days in September and 17 after this month. Forty-one days (23 in September) have had an average of 50 to 99 per hour, "B" days. On 105 days we have tallied less than 50 hawks per hour, "C" days, and these have been divided almost 50/50 between September and the months following it.

Essentially, this presents the picture of what we have seen over 13 years of fall hawk watching. Why we have been able to see it at all has been a question whose answer we have been trying to piece together for a number of years. The pieces are now beginning to fall into place.

A most obvious requirement of a large hawk flight is a terrain suitable for soaring hawks. The production of thermals or updrafts seem necessary for major flights of buteos. The combination of a long range of hills bordering a large body of water such as we have at Duluth, provides this requirement (Olson, 1952:112–113). This free ride down the updrafts was a generally satisfactory answer for the first two years when two weekends of each year yielded a total of over 22,000 hawks. Later our failure to find records of large flights any farther north than Two Harbors (27 miles northeast of Duluth) put considerable doubt on our original interpretation.

It now was obvious that Duluth itself was a concentration point at the tip of the funnel provided by the Sawtooth Range and Lake Superior. By 1954 we had come face-to-face with the fact that every day, even if the weather was nice, was not productive. An examination of weather reports indicated that we could not expect large flights without winds with a westerly component. This has been borne out since, because we have no "AA" days unless the average winds were from the west to north–northwest. There was one "A" day in which the average winds were east–southeast, but a check of the direction on an hourly basis showed that 1,029 of the 1,251 hawks counted were seen during hours when the winds were north–northwest.

While we have had no days when there were big flights without westerlies, we have had several days with westerlies when the counts were average or even below average. However, most of these have been after the main Broadwing flight had passed and before the big Redtail push had started.

Two other weather patterns of some consequence were that the origin of large flights usually followed a day or two after the passage of a cold front and frequently on a rising barometer.

Prior to 1963, I was quite confident in predicting that, if we observed with reasonable frequency during the month of September, we would have no trouble in seeing 30,000 to 40,000 hawks each season. My confidence was greatly shaken after the 1963 season. We had our favorite lookout manned during 19 days in September and daily checks were made on other days to make sure that no major flight escaped us. Yet, our total September count

TABLE 2

THE DISTRIBUTION OF HAWKS RECORDED AT THE DULUTH FLYWAY PER WEEKLY PERIOD OF OBSERVATION

Date	No. Observation Days	Hours of Observation	Sharpshin	Cooper's	Goshawk	Broadwing	Redtail	Roughleg	Kestrel	Merlin	Peregrine	Osprey	Marsh Harrier	Turkey Vulture	Bald Eagle	Golden Eagle	Others	Unidentified	Total	Avg/day of observation	Avg/hour of observation
1–7 Sept.	6	24.5	2,335	60	3	1,117	26	0	184	13	2	11	182	14	2	0	3	1,456	5,408	901	221
8–14 Sept.	37	239.2	8,162	543	33	33,143	234	4	842	133	23	152	631	60	21	1	16	3,488	47,486	1,283	199
15–21 Sept.	40	270.6	10,506	241	49	47,171	817	60	734	101	52	178	1,051	271	21	11	9	9,012	70,234	1,757	259
22–28 Sept.	29	158.5	4,355	113	76	11,718	596	9	338	33	25	49	250	356	17	3	0	1,350	9,288	320	58
29 Sept.–5 Oct.	23	71.5	2,850	48	211	15	667	49	126	18	4	9	150	55	1	0	0	182	4,385	190	61
6–12 Oct.	24	67.2	4,456	55	116	23	1,028	37	59	13	3	5	111	35	4	0	0	236	6,181	257	92
13–19 Oct.	14	39.2	787	5	96	0	1,738	44	9	8	4	0	63	5	0	4	0	850	3,613	258	92
20–26 Oct.	7	12.7	21	0	57	0	89	24	0	0	0	0	2	0	0	0	0	160	353	50	27
27 Oct.–10 Nov.	20	38.2	3	1	552	0	1,373	329	1	0	0	1	2	1	8	5	1	118	2,395	119	62
25 Dec.	1	1.3	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4	3
Total	201	922.9	33,475	1,066	1,197	93,187	6,568	556	2,293	319	113	405	2,442	797	74	24	29	16,852	159,397	792	172

was only 4,543 and 2,593 of those came through on one day. I felt that the unusually fine weather throughout this month had delayed any mass movement and that as soon as we got a westerly, we would get our flight. This never did materialize. During the month we had 14 days of winds with a westerly component. Four of these came the first week, four during the middle and usually most productive part of the month, and four during the last week. On the eight days that we had observers on the hill, not one produced a count above the "C" category. We considered three possibilities: the main flight preceded the first of September; the flight passed over at such a height that we failed to detect it; and that a major concentration just never formed. My personal opinion leans toward the latter. I believe that westerlies have only the power of concentration at particular lookouts, and that the hawks move in everything but inclement weather once the migration gets under way.

With all these things in mind, it seems necessary to look into the origin of our flight in order to understand why they should concentrate at Duluth at all. Duluth is not a natural concentration spot in the same way that the point of land in Ontario bounded by Sarnia–Amherstburg–Toronto–Midland would be. Therefore, it is necessary that several factors operate and that the supply of birds come from more than one area.

When we first see the hawks from the Skyline Boulevard advantage point, we see them almost directly east or northeast of the lookout. On a few occasions a large group may be seen to the north, but this is rare. When they pass over the lookout they are moving west to southwest. If they drift along the shoreline, they invariably turn west by the time they have reached an area adjacent to Minnesota Point. It can be seen on the map (Fig. 1) that were the hawks to turn south, they would turn and go along the point into Wisconsin. We assume, although our evidence is only circumstantial, that the Broadwing is moving toward the southwest through the Texas–Mexico passageway into Central and South America. Our assumption is based on the decided directional trend of the flight leaving Duluth, and the character of the spring migration in Duluth.

Spring migration of hawks in Duluth is considerable, but does not assume the proportions that we expect in the fall. Missing from spring flight are the large numbers of Broadwings; the Redtails, accipiters, and falcons providing most of the interest. The only record that I have of a major Broadwing flight comes from the account in Roberts (1932:321) of thousands that alighted in the tree claims and groves near Wheaton in western Minnesota. If the fall movement is to the southwest as we believe, then the return could be expected to be from this region and therefore there would be no pileup in the Duluth area.

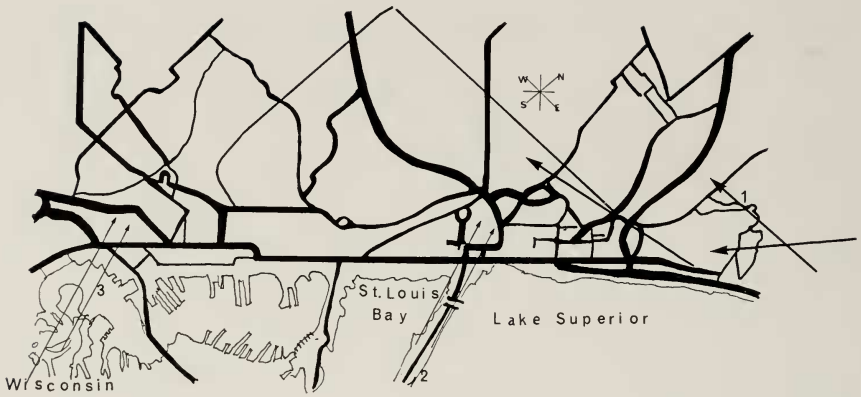

FIG. 1. Duluth. The coarse arrows on the right side of the map show the primary paths of the fall hawk flight. The fine arrows show the primary spring flight paths as they cross Minnesota Point (2) and Spirit Lake (3). Number "1" indicates the site of the chief lookout.

The major spring movement of hawks that we have detected in Duluth proceeds from south to north along a noticeable front extending from Spirit Lake in West Duluth to Minnesota Point, therefore coming from Wisconsin into Minnesota.

There seems to be a tendency for the avoidance of even small bodies of water by large numbers of migrants, occasionally groups making abrupt right angle turns and following a stream rather than crossing it. And yet, migration over the Gulf of Mexico (Lowery, 1946) is well documented and Perkins (1964:294–299) lists 17 flyways across the water of the Great Lakes. It is interesting to note that in reports such as that of Perkins, no major hawk flights over the lakes have been cited.

If, then, we have no major lake flight, and there is no known following of the north shore of the lake, why do they appear in Duluth in such large numbers?

The correlation between water barriers and a southwestward trend to the major movements (see Fig. 2) would indicate that major crossings of water should occur just before the flight reaches Lake Ontario, at the triangle formed by Lake Huron, Lake Erie, and Lake Ontario, and in the Whitefish Bay area. A look at this map would suggest that the heaviest concentration would be in the Huron–Erie–Ontario triangle, and this by all reports is true. It would not suggest a heavy flight on western Lake Superior. Then it seems logical that perhaps some island hopping is done to bring flights east of Duluth to the area. Dr. A. E. Allin of Fort William (personal correspondence) frequently has suggested that large numbers may leave via Isle Royale

striking the shore just north of Duluth. He based this belief on the lack of concentration near Fort William and reports of some numbers near Silver Islet and Isle Royale. A secondhand report that I received of a pilot noting "thousands" of hawks over the lake might lend additional supportive evidence. However, as yet, none of our observers have noted signs of a major concentration over water, although this could be because of observer position, and because frequently flights of major proportion are so high that the casual observer would not notice them.

Mueller and Berger (1961:183) suggested that wind drift caused flights to be brought in against the shores of large lakes. Since the lakes served as guidelines and because of a natural tendency to avoid water passage, large concentrations might occur at certain points. I find this difficult to accept as an explanation for our area. All of our observations have shown that the hawks quarter into the wind, shifting their position with even slight wind shifts and even using a different vertical position under conditions where it appears that the wind direction is different at altitudes under other than ground conditions. However, thermal drift may have some bearing. Flights that form in the valley below our lookout do not start until there is a thermal to rise on. There seems to be little doubt that these thermals are important in the mass migrations of at least the buteos. They use these thermals to rise, sometimes to tremendous heights, and then, peeling off, they glide sometimes for long distances to the next thermal. On some days it appears that they do not use flapping flight at all while they are in the range of our binoculars. If these thermals are free entities and not fixed columns of air (Cone, 1962), then these may serve as concentrators, also. The drifting of the bubbles on westerly winds would present the possibility of considerable drift of kettles of hawks east of the normal directional trend, eventually piling up against the large body of water (Lake Superior) where the thermals are not formed (Hofslund, 1962:91).

One last point, and this is one that may have been ignored by most persons searching for factors explaining hawk concentrations, is the distribution of vegetation. The large forested areas that serve as the main reservoir for woods-dwelling hawks form a triangle that terminates at the Great Lakes (Fig. 2). There is a possibility that these hawks have a reluctance to leave wooded areas and, therefore, the temperate steppes and grasslands of central North America may prove to be just as important a barrier as large bodies of water. It should be noted here that we get only a scattering of the hawks that could be considered as westerns. We have no record of the Ferruginous Hawk (*Buteo regalis*), Prairie Falcon (*Falco mexicanus*), or Swainson's Hawk (*Buteo swainsoni*) using the flyway in the fall. The Krider's race of Red-tailed Hawk, the melanistic phase (so-called Black Redtail) usually associated with

Fig. 2. The cross-hatched portion shows a rough distribution of the coniferous forest areas; the dotted, deciduous forests; and the striped, the steppes and prairies which affect the Great Lakes flight. Arrows indicate possible sources of supply for major Great Lakes lookouts: 1. Duluth, 2. Midland, 3. Sarnia, 4. Amherstburg, 5. Port Stanley, 6. Toronto, 7. Hawk Mountain.

the western race of the Redtail, and Harlan's Hawk (*B. harlani*) are our only evidence that there is an eastward movement into our region. We have been unable to get a picture of the banding operations carried on in Minnesota or to the north of us. However, it is worthwhile to notice that the three forms not seen in Duluth are essentially those of the treeless area, while the other forms might be more closely associated with forests or at least tree claims. If the above assumptions are true, then at least a portion of our flight does come from the west and concentration near the tip of Lake Superior could be expected.

There remains a considerable amount of work necessary for checking the

validity of our guesses, and we are considering the use of radar, airplane reconnaissance, further consideration of the operating meteorological factors, and, of course, continued observations during the full flights. As time, equipment, and money become available, we expect to present a more accurate picture.

SUMMARY

Duluth, Minnesota, can lay claim to one of the great hawk flyways of the world. The consistency of the flyway through the fall migration is quite remarkable when one considers that it does not appear to have the natural features apparent in some of the other Great Lakes areas. Therefore, it is paramount to search for more than one factor operating toward making it a major migration focal point. The factors that we believe are important are: a modified funnel formed by the lake and a range of hills, with Duluth at the funnel tip; a forest triangle that would direct both western and eastern breeding birds toward Duluth; a natural tendency of the hawks to move toward the southwest; free-moving thermals that could pile up against the lake on winds with a westerly component; and the possible effect of Lake Superior as a guideline. We assume because of these factors, that our supply comes from the east through a possible island hopping, the west from natural tendencies to stay with the forested areas and the movements of thermals on a westerly wind, and from the north by virtue of the natural funnel previously mentioned.

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